Chapter 2
The Space Race

The extraterrestrial competition between the Soviet Union and United States that began in the late 1950s gave prominence to some of the potential meanings of space exploration to the exclusion of others. By the 1960s, serious analyses had begun to appear in social science publications, and major polls like Gallup and Harris included items about the space program (Goodwin 1965). Initially, few citizens understood anything about spaceflight, or much about the solar system, so one trend reveals increasing awareness. Depending on exactly what questions were asked, citizens always showed great disagreement over what priority should be given to the American space program. Generally the majority was opposed to increased funding, but there was sufficient public support so that political elites could invest in the program. An additional facilitator of constant support was the usually non-partisan nature of the program and support for it, although competition with the Soviet Union was the broader political factor encouraging progress.

This chapter will raise many issues considered more deeply in later chapters, but it also continues the discussion of the role of leaders in setting the terms of public opinion. These leaders are of two kinds. Some are members of the general public, typically better educated than the average, better informed, and more influential in their local communities. In the jargon of sociology they are called *opinion leaders*, because they are leaders *within* public opinion. Others are prominent in social movements, political factions, and established interest groups. We can call them *organization leaders*, who influence public opinion from outside, being or seeking to become members of a societally influential elite class. Both concepts raise questions about the nature of democracy, to which we shall return in the concluding chapter.

During the Space Race, the general public was primarily a passive observer, organization leaders were dominant, and opinion leaders functioned as mediators. This certainly does not mean that public opinion polls are useless to understand the meaning of spaceflight during this time. Quite the opposite, because they help us to identify the messages that were being transmitted to the public, and to begin to understand how spaceflight connected to some values that various members of

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the citizenry already held. Advocates for the space program tend to view polls as marketing advice, highlighting which of the potential meanings of spaceflight they should emphasize in their propaganda. But they can also provide insights about what spaceflight could really mean for human beings more generally, and thus potentially providing guidance about what kind of space program, devoted to what goals, we might want to create for the future.

2.1 Public Indifference

One remarkable aspect of this situation is the fact that there did not exist vocal foes of space exploration, whose public arguments dissuaded citizens from supporting it. This was not the case, of course, for many other public issues. The most extreme example was the Civil War, 1861–1865, which school children are taught was fought to end slavery, but which also involved issues of state's rights and competition between two fundamentally different economic systems. A more recent example was prohibition of alcoholic beverages, 1920–1933, which was promoted by the Temperance social movement, and opposed by liquor companies, taverns, and their customers (Gusfield 1963). During the period 1950–1970, three political issues were bipolar: the crusade to suppress Communists and comparable radicals inside the United States, school desegregation and the Civil Rights Movement, and the Vietnam War. Space exploration was not a bipolar issue, because the social movement promoting it lacked a clear political opponent.

Throughout this book we shall emphasize the many reasons why people might support space exploration, each of which identifies a different possible meaning it might have. Yet meanings can be found on the negative side of the public opinion ledger as well. Here are four possible explanations for public indifference:

1. Ignorance: Many people may simply lack information that would provide a meaningful context for coming to a well-grounded opinion.
2. Cost: An aggressive space program is expensive, and the money invested could be used by government for a better purpose, or returned to the taxpayer.
3. Irrelevance: However glorious space exploration might be for the engineers and astronauts who undertake it, there may be little or no significance for the daily lives of average citizens.
4. Discomfort: Like many other branches of science, astronomy and related fields contradict the traditional myths that have afforded comfort to individual people and that provided systems of values to organize successful societies.

These four can be combined, and it is entirely possible that all of them were at work, reinforcing each other in complex ways in the minds of various citizens. Opinion poll data can evaluate some of the four, but a very major social scientific research project would be required to disentangle their effects and determine their relative strengths. Here, the most we can do is provide analysis that documents and clarifies them to a moderate extent, adding more depth in later chapters.

Public *ignorance* of the subject matter of space science is profound and continues today, but was more extreme in the early days (Smith 2003). With respect to ignorance, I "conducted a tiny poll" on July 21, 1969, with just two respondents. To call it a "poll" is an exaggeration, but it was an informative experience. I watched the televised moment when Neil Armstrong took his famous step on the lunar surface, in the company of an uncle and an aunt. Both were college educated intellectuals, but neither was aware that the Moon lacked a breathable atmosphere.

Rather more substantial were two polls conducted in the United States roughly 6 months before Sputnik I and 6 months afterward, with 1,919 and 1,547 respondents (Swinehart and McLeod 1960). At the earlier point in time, the news had already carried stories about the plan to launch the first American satellite called Vanguard during a symbolic period of international focus on science, the International Geophysical Year 1957–1958, but only the launch of Sputnik made many in the general public take notice. In the earlier survey, only 21 % of respondents could suggest any purpose for such a satellite, compared with fully 64 % afterward. Of respondents to the later survey, 20 % cited competition with the Russians, and 17 % cited future possibilities. Scientific goals were mentioned by 27 %, but only 11 % could be specific about what these scientific goals were.

At that point in the history of social science, research about the impact of the mass media was at its height, especially concerning the debate about the role played by relatively well-educated opinion leaders that was introduced in the previous chapter in the discussion of the Martian invasion "panic" of 1938. One standard finding was that opinion leaders paid attention to somewhat different sources of information than did the average citizen. Today, many educated people get their news from Internet, and magazines are in serious decline as both a source of information and a business. But in 1957, according to one survey, 44 % of people who had attended college primarily got their news from magazines, compared with 39 % from newspapers, just 15 % from television, and 1 % from radio (Wade and Schramm 1969). Newspapers did not show much difference by education, 42 % of people who had not even attended high school primarily using this medium. But only 13 % of this least-educated group cited magazines, 34 % get their news from television, and 6 % from radio.

Given the dominance at that time of the NBC, CBS, and ABC networks, broadcast media may have promoted more narrow perspectives on spaceflight, than did magazines which then included not only *Life*, *Time* and *Newsweek*, but also a great variety of specialty periodicals. *Collier's* magazine famously promoted the spaceflight movement through many excellent articles in the first half of the decade. In that same 1957 survey, 38 % of magazine readers knew some scientific information about Earth satellites, compared with 22 % of newspaper readers, 16 % of TV viewers, and 10 % of radio listeners. After Sputnik, in 1958, these levels of awareness had all increased, to 47 % for magazines, 34 % for newspapers, 25 % for television, and 19 % for radio. Whether resulting from low education or low quality news media, ignorance varied and generally declined in the wake of Sputnik, but is a continuing issue even today.

Data from the January 1969 Harris poll #1877, available to anyone from the Odum Institute at the University of North Carolina, elucidate the *cost* issue

Table 2.1 First priorities to cut or keep among government programs in 1969

Government program	Cut (%)	Keep (%)
Aid to cities	5.1	5.4
Anti-poverty program	6.1	18.3
Space program	40.7	1.3
Subsidies for farmers	6.5	3.3
Aid to education	0.6	20.2
Medicaid	1.6	8.4
Anti-air and anti-water pollution programs	1.7	6.9
Welfare and relief	9.5	8.0
Building more highways	8.6	0.8
Financing the war in Vietnam	18.4	3.9
Anti-crime and law enforcement program	1.1	23.4

(www.irss.unc.edu/odum/home2.jsp). This was immediately after the flight around the Moon by Apollo 8, heavily covered in both print and broadcast mass media, and when the general public expected an actual lunar landing soon. Thus one would think that support would have been at a high point. With respect to cost, many of the opinion polls explicitly posed questions about space exploration in terms of the investment required, and one such question from polls administered after 1972 will be the focus of the following chapter. Most surveys asking about space program funding presented it as a somewhat separate question, one among many questions about funding for government programs, but answerable independently of other programs. This Harris poll asked a very different kind of question, focusing the mind of respondents on the trade-offs. The interviewer's questionnaire administration instructions stated it thus: "Now I want to give you this list (HAND RESPONDENT CARD 'B') of government programs. If *one* program had to be reduced, which *one* would you cut first?" Table 2.1 shows the results, plus the responses to a second question asking which program "you most like to see kept or even increased."

Of the 1,436 respondents willing to suggest which program to cut, fully 40.7 % put the space program on the chopping block, and only 1.3 % of the 1,444 willing to identify their top priority to save selected it. More than twice as many wanted to cut funding for the space program than the runner-up, which was the Vietnam war. This does not mean that they lacked all appreciation for it, but when presented with the harsh trade-offs for investment of public money, they became discouraged.

Another question in the same 1969 Harris poll illustrates the related issue of *irrelevance* to the every-day life of the respondent. It asked: "How would you rate the state of your health—would you say it is excellent, pretty good, only fair or poor?" Another question asked: "Do you favor or oppose the space project aim of landing a man on the moon?" Table 2.2 cross-tabulates these two, using the 1,252 respondents who had some kind of health insurance to reduce somewhat any tendency for the results to be dominated by cost considerations, and using this particular space question for the same reason, because it does not mention cost.

Table 2.2 Health and support for a landing on the Moon, 1969

Health	Favor Moon landing (%)	Not sure (%)	Oppose Moon landing (%)
Excellent	51.3	11.2	37.5
Pretty good	39.1	12.7	48.1
Only fair	26.1	14.6	49.2
Poor	12.0	20.0	68.0

The results could hardly be more striking, given the fact that many variables shape responses to survey questions. As health declines, support for a Moon landing drops from 51.3 % all the way down to 12.0 %. In later chapters we will examine the effect of age, which is complex but universally shows low support for space projects among the elderly, and they tend to face many health problems. People who are economically poor may also disproportionately have poor health, both as cause and effect of poverty. Whether because of low education or their appreciation for government anti-poverty programs, they may oppose space programs. But all those factors aside, I believe we can read something else into this table. People whose concerns are very much focused on their own personal condition, in this case ill health, will be far less interested in grand projects that are irrelevant to their own immediate needs.

Discomfort is a deep issue, and therefore difficult to disentangle from other issues. Consider the history of astronomy and physics. We revere the memories of Copernicus, Galileo, and Newton precisely because they taught us to think in new ways about the universe, ways that may not have been "natural" even though they illuminated the facts of nature. Humanity evolved in East African forests and savannahs, then spread around the globe sufficiently rapidly that our cognitive evolution could not keep pace with our geographic expansion. We see this in the difficulty humanity experienced in devising cultural structures to sustain societies much larger in scope than the tiny hunter-gatherer bands the biological evolution suited us for (Lévi-Strauss 1969). We also see it in how slowly humanity came to understand the shape and dynamics of the solar system.

While many myths have arisen about Stonehenge, having stood within its circle, and leaned against the Heel Stone, I can well believe that it was arranged to mark the apparent motions of the sun across the sky, fully 5,000 years ago. Some ancient Greek scientists appreciated the possibility that the Earth was round, but until navigators circled it in the much later Age of Discovery the general public conceptualized it the way their eyes testified: flat. Thomas Kuhn could title an influential book *The Copernican Revolution*, because humans instinctively assume their world is the center of the cosmos, and would feel uncomfortable to sense that their world is spinning around (Kuhn 1957). In a lecture I attended, innovative visionary Buckminster Fuller reported that he liked to stand looking at the horizon and fully sense how fast he was zooming through space, but most people might find this experience disconcerting or even terrifying. In so doing, they extrapolate from the narrow confines of their daily existence, where falling fast is extremely dangerous.

The most informative other example is the human reluctance to accept the full implications of Darwin's theory of evolution by natural selection from random genetic variations (Bohannon et al. 2010). In this case, unlike the situation with spaceflight, there exists an opposition movement, Creationism, which asserts God created us directly, for his own divine purposes (Numbers 2006). H. Porter Abbott has argued that reluctance to accept evolution is not merely a reflection of commitments to a set of ancient beliefs, but reflects a standard feature of human cognition. Abbott is a leading scholar of narrative, having written extensively about its roles and variations in literature. In one essay published in a collection about cognitive science, he argued that the theory of evolution from natural selection is unnatural because it is *unnarratable* (Abbott 2003). Human action is guided by purposeful thinking in terms of a narrative in which a person seeks a goal, must overcome a series of obstacles, progresses by assembling resources, recruiting allies, and seeking a path forward. Our brains evolved to think that way, because such thinking was advantageous in our mundane lives, but it is not conducive to any deep acceptance of the theory of evolution by natural selection from random variation.

The same may be true for the revolutionary perspectives that waited thousands of years until individuals with exceptional minds in rapidly changing societies could conceptualize them, namely Copernicus, Galileo, and Newton. Two kinds of poll data bear on the discomfort factor: (1) religious beliefs, and (2) stereotypes of scientists. They will be covered in Chap. 6, and the next task here is to consider the implications of the dawn of the Space Age, which began as a race.

2.2 A Growing Awareness

Long before the Second World War developed technologies on which real spaceflight could be built, small segments of the population were thinking about the possibilities. As we shall document in some detail later in this book, science fiction fans had been dreaming of voyages to other worlds since late in the nineteenth century. Some members of the public were interested in astronomy, for example reading *Sky and Telescope* magazine since it was first published in 1941, and indeed many of America's large telescopes had been funded by private donations. Further afield, professionals and students in all of the non-biological natural sciences would have learned something about the structure and dynamics of our solar system, and thus could see the plausibility of spaceflight. However, serious technical knowledge could also raise doubts, for example the awareness that the velocity a spaceship would need to achieve to escape the Earth's gravity, assuming reasonably enough that it launches from the surface, was fully seven miles a second.

The launch of Sputnik I from the Soviet Union, October 4, 1957, was a momentous public relations coup, and presented American president Dwight David Eisenhower with a multiplicity of problems. He was quite aware that both nations were far along on developing nuclear-armed intercontinental ballistic missiles, but had been constrained in how much he could reveal to the public. Anyone

at all familiar with the technology would have known that the US could have launched the first satellite years earlier, had that been a priority. A good source of public information today was not available then: a page of the website of the Eisenhower Presidential Library devoted to Sputnik. Its introduction remarks:

> Rather than celebrating this momentous scientific feat, Americans reacted with a great deal of fear. The event came at a period near the end of the McCarthy communist "witch hunts," a time when schoolchildren were involved in "Duck and Cover" air raid drills, and citizens were encouraged to build their own civil defense shelters. It was widely believed that if the Soviets could launch a satellite into space, they probably could launch nuclear missiles capable of reaching U.S. shores.

That concern might not be moderated by the awareness that the US Air Force had long been in a position to destroy the Soviet Union. In December 1958, the US launched the first communications satellite, Project SCORE, broadcasting Eisenhower's own voice: "This is the President of the United States speaking. Through the marvels of scientific advance, my voice is coming to you from a satellite circling in outer space. My message is a simple one: Through this unique means I convey to you and to all mankind, America's wish for peace on Earth and goodwill toward men everywhere." All well and good, but what astonished me personally when SCORE achieved orbit was that it consisted of an entire Atlas intercontinental ballistic missile, minus the two extra engines it used at launch. Now, scanning the documents available on the Eisenhower Library's website, I especially note a statement about Sputnik from the National Science Board:

> The significance of the Soviet accomplishment in exploring outer space has been considered at length by the Board of the National Science Foundation. The Board regarded this as a great scientific and technical accomplishment; and urged that it be recognized as such. The Board further considered it an impressive demonstration of the strong position of Russian science and education… We must recognize that our nation's future rests in major degree upon the soundness of our system of education and our people's respect for scientific endeavor, based on an understanding of its importance in the modern world.

Such a statement has two kinds of meaning. First, its meaning is contained in the document itself, stating that Sputnik was a great scientific achievement, reflecting the strength of science and education in the Soviet Union. Second, it was an expression of the vested interest of the authors. The National Science Board is a committee of Presidential appointees, scientists themselves and mainly academics, with two responsibilities: (1) to carry out oversight of one US government science agency, the National Science Foundation, and (2) to advise the president on matters related to science. The Board's statement does not refer to rocket science narrowly, but to science more generally, and thus is advocacy for support of NSF, as well as contributing to the expansion of the National Advisory Committee for Aeronautics (NACA) into the National Aeronautics and Space Administration (NASA) over the following months.

Public reactions to Sputnik looked both forward, to what America might now accomplish in space, and backward. On October 10–15, 1957, just days after the launch, the Gallup Poll asked 1,573 American adults, "How long do you think it will be before men in rockets will reach the moon?" Respondents were about

equally split, 52 % being willing to provide a definite prediction, and 48 % unwilling. On November 25, 1957, less than 2 months after Sputnik, Gallup included an open-ended question: "Where, specifically, would you put the blame, if anywhere, for letting the Russians get ahead of us in developing rockets and missiles?" The poll takers wrote down the respondents' verbal answers, and Gallup collected phrases into groups during a rough analysis of these non-quantitative data:

The president, Eisenhower, the White House
Leaders of Government, General; no specific individual group, or party mentioned; the politicians
Congress, Senators, Congressmen (no reference to appropriation of money)
The Republican Administration, the administration, the present administration, the government
(Congressional) cut-back in defense budget, not enough money, curtailment of funds by (Congress)
Charles Wilson, Defense Department
Inter-service rivalry, jealousy between forces, competition between Army, Navy, Air Force
Preceding Administrations, Roosevelt, Truman administration
All Americans, everyone is to blame (no mention of why or how)
Our complacency, smugness, cocksureness, neglectfulness, etc., not enough attention paid to business, too lazy
Lack of major party cooperation, Dems and Reps fighting each other
Russian espionage, spies got information, our know-how "leaked out," poor security
Not enough scientists, good scientists
Our failure to get the most (best) German scientists
Inadequate educational preparation for science, not enough stress on education
U.S. gave away too much information, too trusting
Poor planning, mismanagement, not enough emphasis on rockets, missiles
Restriction on scientists
No one is to blame
Doubts, does not believe Russia is ahead.

The question emphasized the word *blame*, and respondents may not have felt inclined to argue against an expensive American space program. People were not, for example, saying, "The Soviet Union was able to launch Sputnik because it has a totalitarian form of government, and therefore can waste money on worthless projects that a free democracy should ignore." Of course, the serious shock among American leaders about Sputnik was not so much about the Soviet decision to launch an Earth satellite, but their technical ability to do so.

The wider world was an attentive audience for the Space Race, from the launch of the first Sputnik until the last Apollo landing. Of course, citizens of the Soviet Union took pride in the early achievements. Some may have considered them proof of the superiority of Marxism, and others would have experienced them in more nationalistic terms. More widely, they could draw optimism about their own

Table 2.3 Percentage differences thinking Russia was ahead of the United States after Sputnik

Nation	Scientific discovery		Military strength	
	November 1957 (%)	October 1958 (%)	November 1957 (%)	October 1958 (%)
Great Britain	38	−13	31	15
West Germany	−4	−21	−15	−1
France	38	14	8	9
Italy	14	−3	−12	−15

futures, just a dozen years after the conclusion of the Second War that had been fought on their own territory and cost the lives of perhaps twenty million of their fellow citizens. In 1994, 2,400 residents of Russia gave their reaction to a list of prominent events from the previous half century, one of them being the launch into orbit of a dog named Laika in Sputnik II, November 3, 1957. This proved to be one of the best-known events, especially so among respondents who were children at the time Laika became the first space traveler (Schuman and Corning 2000).

People in many nations were impressed by the first Soviet satellites. Polls administered in four nations allied to the United States asked "All things considered, do you think the U.S. or Russia is ahead in scientific development at the present time." A second question asked the same for "total military strength." For example, in November 1957, only 20 % of British respondents thought the US was ahead, while fully 58 % thought Russia was ahead, a difference of 38 % points in favor of Russia. Table 2.3 shows the percentage differences across the four US allies at two dates, the second being a year after Sputnik when the US had also launched satellites. Minus signs indicate the view that the US was ahead of the USSR (Almond 1960).

It is hard to know when pollsters are asking leading questions that implicitly urge to respondents to answer in a particular way. Yet perhaps many people really did think that scientific discovery was a unitary phenomenon that could be illustrated by just one example, let alone the rather distorted notion that being able to launch satellites on converted military missiles was "scientific discovery." The first significant discovery, the van Allen radiation belts around the Earth, was in fact made by the first American satellites, not the first Soviet ones. A reasonable argument could be made that the ability to launch satellites required excellence in several fields of engineering, which could not be achieved without excellence in several areas of science.

A report prepared for the US Congress that reflected upon Sputnik in 2009 noted, "The United States faces a far different world today than 50 years ago. No Sputnik moment, Cold War, or space race exists to help policymakers clarify the goals of the nation's civilian space program." (Stine 2009) Yet it could be said that organization leaders saw Sputnik less as a clarification than as an opportunity, because it provided ammunition for some of them to promote goals they were already committed to.

2.3 Exploitation of the Situation

As the previous chapter noted, public opinion develops though complex processes of communication and influence, which leaves it vulnerable to manipulation by social movements and interest groups. In the context of the Sputnik Panic, three such entities can be readily identified: the Democratic Party, the military-industrial complex, and various reform movements within the educational establishment. Without taking a political stand, or expressing sympathy or antagonism toward any of these three, their roles in shaping the meaning of spaceflight can be outlined.

The November 25, 1957, Gallup Poll documented a fairly widespread sense that President Eisenhower and his Republican administration had failed to anticipate and then preempt the impact of the early Russian satellite launches. Quite reasonably, Sputnik raised concerns that the USSR might be building a vast fleet of intercontinental ballistic missiles to attack the United States, although from the Soviet perspective such a missile armada might be only a counterbalance to the huge American superiority in bomber aircraft, leveraged by the fact that the US had many airbases within striking distance of Mother Russia. The Democratic Party began to exploit this situation, asserting that a missile gap existed because the US was obviously far behind the USSR.

While the missile gap theory was reasonable, it also served political purposes. Given how close the vote counts in the 1960 presidential election turned out to be, it is conceivable that the missile gap hysteria gave John F. Kennedy the victory. The loser, Richard Nixon, gained the office 8 years later, and it boggles the mind to contemplate how history more generally might have been different, had he become president at his first attempt, and before the US had gotten embroiled in the Vietnam War. There is good reason to believe the Apollo Program would not have been launched had the Democrats not asserted the missile gap and Nixon had become president in 1960.

In retrospect, it is clear that the missile gap did not exist (Dick 1972). The United States had considerable flexibility in which aspects of its vast military establishment would play what role in deterring Soviet aggression, chiefly in Europe where it was most feared. But the early Soviet ICBMs were too costly, unreliable, and few to outweigh the deterrence already possessed by the US, who had the technical and economic ability to field better missiles faster. The rush to deploy the first ICBMs promoted the kind of rocket technology useful for spaceflight, namely liquid-fuel rockets, but already 5 years after Sputnik the solid-fuel Minuteman ICBM was going into service, more efficient and easier to hold in readiness. Among the factors making Minuteman and the submarine-launched Polaris missiles feasible were advances in nuclear weapons and guidance technologies that produced much smaller warheads. The Mercury and Gemini astronauts were launched on modified Atlas and Titan ICBMs. Thus, one aspect of the Space Race was technical, to promote spaceflight before some of the military technologies had been perfected.

It would be an oversimplification to say that the Moon program was funded because it served the interests of the "military-industrial complex," yet there is some truth to this claim. The very concept sounds like bombastic nonsense uttered by a sociologist, or even nasty Marxist propaganda. But it was introduced into American

intellectual life by one of the very most trusted political and military leaders that America has ever produced, president and general Dwight David Eisenhower. He did so in his extremely prominent farewell address to the nation, January 17, 1961.

Interested readers may consult the several versions of Eisenhower's intellectually rather deep lecture, which I watched with amazement as he originally gave it on television, on the website of the Eisenhower Presidential Library. I was especially astonished when he said, "In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist." He specifically warned that science policy could be horribly distorted by the military-industrial complex, but also mentioned the possibility that science itself might gain too much influence. At the time, I was aware that he had not vigorously supported an aggressive manned space program, and that his vice president, Richard Nixon, had lost the election that decided Kennedy would be his successor in part because of claims that the Republicans had allowed that "missile gap" to exist between the USSR and USA. So I understood Eisenhower to be defending his past indifference toward science, and only in later years did I come to appreciate how well he had framed very legitimate issues.

It is very clear that the American educational establishment jumped on Sputnik, as a rhetorical resource to advance its own agenda, not infrequently sacrificing intellectual accuracy for political expediency. For example, in the April 1958 issue of *The Journal of Higher Education*, Thomas N. Bonner wrote, "Mr. Teller, certainly one of the most knowledgeable and moderate of the scientists who have commented, testified emphatically that it will take us a minimum of 10 years of hard work a full speed before we can hope to draw abreast of the Soviets in basic scientific research and knowledge affecting missile and rocket development (Bonner 1958)." The Teller of whom Bonner speaks was Edward Teller, "father of the hydrogen bomb" who later promoted the space-based Strategic Defense Initiative, which we shall cover in Chap. 5, and who is generally recalled as a "hawk" and not a moderate. Bonner's fundamental argument was not really about Sputnik, although that was the superficial focus of his essay, but about American anti-intellectualism, which many university scholars decried during the years around 1960 (Hofstadter 1963).

Bonner referred to an educational crisis in America, and other authors used the same journal to publish essays demanding reform of curriculum and student support (Hilberry 1958; Graham 1959). Such a crisis may have existed, but Sputnik was not evidence of it, and contrary to Teller's claim the Soviet Union was not ahead of the United States in science. On October 4, 1997, exactly 40 years after the launch of Sputnik I, the Center for Science, Mathematics, and Engineering Education held a symposium at the National Academy of Sciences reflecting upon that great event. Contributors noted that reform movements in science and mathematics education already were active in 1957, but Sputnik gave them a big boost for perhaps two decades (www.nas.edu/sputnik/index.htm). The excessively abstract New Math movement, which did not take much account of the psychology of child development, came under criticism, so not all the reforms facilitated by Sputnik may have been good (Raimi 2012). One good feature of the Sputnik

response was a closer connection between educators and scientists, a bond that may have weakened again subsequently. We have already seen that better-educated people tend to be more supportive of spaceflight, but in the following chapters we will see much evidence that the link between the space program and science education is a tenuous one.

If I may share a personal observation, relevant to education during the Space Race, I was caught up in it immediately after Sputnik. The Choate high school I attended got a phone call from the producers of the tremendously popular television quiz program, *The $64,000 Question*, asking for students who would become contestants to prove how excellent the American educational institution really was. I and a younger boy were sent to New York, and I am not sure how well I did on a written test about the space program, although I know I got one orbital mechanics formula wrong. But I certainly flunked the interview, in which I forcefully stated my belief that the American public educational system was indeed dreadful, and was not invited to become a contestant. Only subsequently, when this quiz show was revealed like some others to be manipulating outcomes in favor of popular contestants, did I realize my tactical mistake.

Perhaps popular opinion, and public understanding of science, belong to the context in which technological innovation takes place, rather than being central to the process of innovation itself. In my book *The Spaceflight Revolution*, I outlined a theory that was based on the historical work of previous scholars on the Space Race, but sought to abstract a model that applied to other examples as well. The model concerned social interaction among three actors in a social system, which could be individual leaders or organizations:

1. The *spaceman*: A leader in the spaceflight social movement who seek resources to advance its goals.
2. The *patron*: A leader in the larger society who has considerable resources at his disposal and is relatively free to spend them without external control.
3. The *opponent*: A leader who is locked in fierce competition against the patron.

For example, the spaceman might have been German rocket engineer Wernher von Braun, the patron might have been Adolf Hitler, and the opponent was the enemies of Germany in the Second World War. In the model, the opponent gains an advantage over the patron, and the patron who is aware of this seeks a countermeasure without quickly finding one. The spaceman can then go to the patron and sell his favorite spaceflight advance as a solution, rightly or wrongly, to the patron's problem of momentary inferiority to his opponent. Here is how the model applies to the case of the Apollo Project, specifically the Saturn I launcher which was the predecessor to the Saturn V that sent men to the Moon:

CASE 14:

PURPOSE: Development of superbooster suitable for lunar and space station missions
SPACEMAN: Von Braun and others in NASA
OPPONENT: The Soviet Union, the Republican Party

PATRON'S INFERIORITY: American spacefaring inferiority as evidence by Russian Sputniks and Gargarin's orbital flight; Kennedy's "New Frontier" in trouble (partly because of the Bay of Pigs fiasco) and needs new visionary boost to regain credibility (Bainbridge 1976).

This was Case 14 of 15 I outlined, the Space Shuttle being the last one, and von Braun's personal pitch to Hitler about increasing investments in the V-2 rocket program was Case 7. Again, the fundamental analysis of my Case 14 had been done by other scholars, especially Vernon van Dyke and John Logsdon (van Dyke 1964; Logsdon 1970). Perhaps this theory gives too much credit to the spaceflight social movement and too little to the military-industrial complex. But, in the context of this book an important point is that neither the general public nor wider scientific community played a decisive role. The general public is the audience for the posturing of politicians, who use scientists and engineers as supporting players in their drama. This does not negate the significance of public opinion, but locates it where it belongs, as an arbiter of the meaning of spaceflight, rather than as its instigator.

2.4 The Vietnam War

During the period of the Apollo Program, the United States fought a politically divisive war in Vietnam, beginning during the Kennedy and Johnson administrations that represented the Democratic Party, and then concluding painfully during the Republican administration of Richard Nixon. Harris poll #1718 was administered in April 1967, and provides a good glimpse of the political implications near the middle of the Apollo Program, about a year and a half before the first manned mission, Apollo 7, which tested the vehicle in Earth orbit. This was also several months before the Tet offensive in the war that galvanized popular opposition.

The questionnaire included three fixed-choice questions about spaceflight, which were also included in several other Harris polls of that general period. The first put the program in the context of government funding: "It could cost the United States $4 billion a year for the next 10 years to finally put a man on the moon and to explore other planets and outer space. All in all, do you feel the space program is worth spending that amount of money on or do you feel it isn't worth it?" Of the 1,177 respondents who answered this question in April, 32.9 % felt the investment would be worth while, 54.5 % felt it would not be worth it, and 12.6 % were unsure. Thus, a majority of the public was against an ambitious space program.

The second question put the issue in the content of international competition: "If the Russians were not in space, and we were the only ones exploring space, would you favor or oppose continuing our space program at the present rate?" Now, only 29.0 % were in favor, 60.4 % opposed, and 10.6 % unsure. This indicates that competition with the Soviet Union was indeed a factor in shaping public opinion about spaceflight, although not really decisive because it had not tipped the balance over to a majority supporting a vigorous space program.

The third question was focused more narrowly on the Apollo Program: "Do you favor or oppose the space project aim of landing a man on the moon?" Now, 41.8 % were in favor, 47.0 % were opposed, and 11.2 % not sure. This item differed from the others in two ways: (1) It did not emphasize the great cost. (2) It focused on the single goal of reaching the Moon. The fact that support was somewhat stronger for this item suggests that the public was not prepared to give NASA a blank check without a clear understanding of what would be accomplished, and that an expedition to the Moon had somewhat clear and positive meaning. However, none of the three questions indicated a majority in support.

Given that Apollo was a Kennedy initiative, continued by Johnson, it may have been more popular among members of their own party, the Democrats. One could argue that aspects of Republican ideology might have favored it as well. The situation is complicated by the ambiguous political meaning of the Vietnam War. Now, half a century later, it is hard to guess how things might have turned out had the 1960 or 1964 elections gone the other way, but thankfully the American stumbling around in Vietnam did not lead to nuclear war. By the 1968 election, substantial opposition to the war had arisen in the Democratic party, and it was left to the subsequent Republic administration to deal with the problem in its own incompetent manner. The objective point to draw from this superficial overview is that both Apollo and Vietnam were connected to the Democratic Party in 1967, so political affiliation may have shaped public opinion about both in a similar fashion.

The first thing to note about political affiliation in the Harris poll #1718 data is that Democrats greatly outnumbered Republicans. Of the 1,164 respondents who answered the first spaceflight question and gave their political orientation, only 30.9 % were Republicans, fully 52.3 % were Democrats, and 13.4 % called themselves Independents. Of these groups, the one showing most support for space funding were the Independents, with 40.4 % calling a $4 billion annual investment "worth it" and 47.4 % "not worth it." Second place in terms of space support was indeed held by Democrats, 33.8 % being in favor versus 54.4 % against. Among Republicans, 28.6 % felt the program was worthwhile, compared with 58.9 % who did not.

In the following chapter we will consider political orientation again, and it is a complex variable. Some Republican opposition may stem from opposition to big spending by government and some from association of Apollo with the Kennedy-Johnson administration. Give that spaceflight is literally "out of this world," its connection to mundane political issues may be unstable, changing markedly over time as the public assigns different meanings to it. Removing competition with the Russians from the equation, as the second Harris question does, reduces spaceflight support in all three political categories, to 32.7 % among Independents, 30.9 % among Democrats, and 24.7 % among Republicans.

All three political categories respond more favorably when the clear goal is reaching the Moon, without an indefinite financial commitment. Among Independents, now a plurality of 48.1 % favored the program, compared with 45.5 % who opposed it. The difference went the other way for Democrats, 42.2 % favoring and 45.5 % opposing. And the difference was even greater among Republicans, 39.3 % in favor and 50.4 % opposed. This suggests that many

Table 2.4 Alternative strategies for the Vietnam war

Opinion	Cases	Worth $4 billion per year (%)	Favor even without Russia (%)	Favor Moon program (%)
Point of view about war in Vietnam				
I disagree with present policy. We are not going far enough. We should go further, such as carrying the ground war into North Vietnam	178	30.9	27.8	40.4
I agree with what we are doing but we should increase our military effort to win a clear military victory in South Vietnam	463	40.0	33.8	50.1
I agree with what we are doing, but we should do more to bring about negotiations such as a cease fire	308	33.1	29.5	42.5
I disagree with present policy. We shouldn't be there. We should pull our troops out now	136	17.6	16.1	22.8
Do you favor or oppose the use of atomic ground weapons in the fighting in Vietnam?				
Favor	113	36.0	31.0	47.6
Oppose	217	33.3	29.2	41.9

Republicans may indeed have associated Apollo with the Democrats, but even the Democrats themselves were not strong supporters. With this background, we can now see what may be revealed by comparing three spaceflight questions with two that Harris asked about the war.

One especially interesting item asked respondents to select one of the four policies listed in Table 2.4. The numbers of cases given in the table are the number giving this response and answering the first spaceflight item, and the numbers are similar for the other two spaceflight items. The patterns are the same across all three space items. Those content with current policy in the war are most content with the Moon program. Those who are somewhat discontented and want moderate changes in policy, either more militaristic or more willing to negotiate, are less enthusiastic, about equally so. Those who were strongly against the war and wanted the US to withdraw from Vietnam were very unenthusiastic about the Moon program. Given that many of those "peaceniks," as they were derisively

Table 2.5 Preparations for nuclear war

Opinion	Ought to be done (%)	Not sure (%)	Should not do (%)	Space item correlation (tau-b)
Build up a system of anti-missile defenses	60.1	16.7	23.2	0.29
Increase the number of airplanes which carry nuclear warheads	48.1	19.4	32.6	0.39
Increase the number of nuclear warhead long-range missiles	51.5	20.9	27.5	0.38
Increase the number of men in the U.S. armed forces	31.1	17.0	51.9	0.33
Give NATO a real capability of waging nuclear warfare	25.1	27.3	47.6	0.34
Convert the space program into a system of nuclear weapon space stations	25.1	26.4	48.6	–

called by those who associated anti-war sentiments with Communism and thus indirectly with Sputnik, would have leaned toward the Democratic Party, they may have reduced the party differences in support for the space program, below what they would have been without the Vietnam War.

At the bottom of the table we see an item that was asked of only a subset of respondents, concerning the use of nuclear weapons in the Vietnam War. They had not been used in the Korean War, for example at the point when China sent its forces into help the North Koreans after their armies had retreated in the face of General McArthur's classic encirclement maneuver at the Battle of Inchon. The question about use of nuclear weapons does not show big differences, but does remind us of the remarkable range of views about them that existed decades ago.

Table 2.5 is based on Harris poll #1900, administered to 1,544 respondents in December 1968, which included some rather chilling questions about "areas where it has been suggested the U.S. military defenses be strengthened," including one about full militarization of the space program. This was a period in history when widespread nuclear war appeared to be quite possible, and strategists debated issues like striking the enemy first, basing peace on mutually assured destruction if war came, and other ideas that seem at best hazardous if not downright immoral to contemplate (Kahn 1960, 1962).

The first item, "anti-missile defenses," came back into prominence in the 1980s with the Strategic Defense Initiative, and 60.1 % of respondents were in favor, versus 23.2 % who were against. It has a correlation (tau-b for two non-parametric items with the same number of response categories) of 0.29 with the last idea in the list, of militarizing the space program. The other items have higher correlations with the space militarization item, undoubtedly reflecting the fact that relatively pacifist respondents could well support a system of anti-missile defenses while being opposed to more aggressive space-related technologies. The Vietnam War took place long ago, much closer to the Second World War than to today, but the range of public opinions about the space program that consolidated during that period persists.

2.5 The Unlucky Apollo

In April 1970, an oxygen tank on the service module of Apollo 13 exploded, as the craft was on its way to the Moon, initiating a remarkably complex but ultimately successful effort to return the crew safely. A week later, Harris Poll #2025 asked 1,520 American adults how worried they were "whether the men in the spaceship would get back to earth," and 54.5 % admitted to being very worried. Another question asked, "Do you expect that on one of the space shots an accident will take place and the astronauts won't get back alive, or do you think that probably won't happen?" Fully 71.2 % anticipated a future fatal accident. Frankly, it is somewhat difficult to frame exactly what these two questions were really measuring. The second question did not specify when a future accident might happen, and given enough years of exploration a fatal accident was bound to occur. In fact, in the context of NASA's manned spaceflight program, it took 16 years until the Challenger disaster for the question to receive an objective answer.

The poll also asked variants of Harris's standard "worth it" items, beginning with: "Getting to the moon cost 4 billion dollars a year for 9 years. Do you feel landing a man on the moon was worth spending that amount of money, or wasn't it worth it?" Just 38.3 % of respondents felt the moon program was worth it, compared with 56.3 % who said it had not been. The other item was the same one from the April 1967 poll about whether space exploration was worth 4 billion dollars a year for 10 years. It showed a slight drop in support, just 29.5 % feeling it was worth it, compared with 32.9 % 3 years earlier.

What makes the 1970 poll really interesting was that it also included many questions about ordinary aviation, stimulated by the fact that the gigantic Boeing 747 had gone into regular service just 3 months earlier. This allows a glimpse into the extent to which people conceptualize spaceflight as an extension of the aviation they experience themselves. One question asked if the respondent had flown with the past year, and another given only to those who had not flown that recently asked whether they had flown within 5 years. Combining the data from these two items identifies 615 respondents who had flown within 5 years, and 817 who

had not. Now this at least partly reflects social class, and we would need a much richer dataset to determine conclusively why the experience of flying should correlate with spaceflight attitudes. But for present purposes we can conjecture that respondents who had flown would conceptualize spaceflight as an extension of an experience they themselves had, thus being more comfortable with the idea.

Of those who had flown, 55.6 % were worried during the Apollo 13 mission, compared with 54.4 % who had not flown, essentially no difference. On the likelihood of a future accident, the percentages were slightly more different, 69.6 and 73.1 %, respectively. But a really big difference appears for the two questions about whether space exploration was worth the money invested. Of those who had flown in the past 5 years, 50.7 % felt getting a man to the moon had been worth it, compared with only 30.5 % of those who had not flown. The percentages for the more general question about investing in space gave lower but also different percentages, 38.2 and 23.8. A battery of 16 questions focused on the Boeing 747, eight of which are tallied in Table 2.6.

Table 2.6 Attitudes about the Boeing 747 and the space program

Agree-disagree statement	Percent agree (%)	Of those who agree with the statement			
		Moon worth it (%)	Program worth it (%)	Very worried (%)	Accident (%)
Bigger and better planes such as the 747 are a sign of sound technological progress	64.4	45.2	35.5	58.1	71.7
At a time when the airlines are faced with rising prices, the 747 will save the airline industry	36.2	44.9	37.2	59.1	73.7
Everyone in the 747 has a clear view of a much bigger screen for the first run movies	47.3	42.7	33.8	58.1	72.5
In the 747, the seats are larger and the passengers can fly with much more comfort	70.2	41.5	32.6	56.2	71.4

(continued)

Table 2.6 (continued)

Agree-disagree statement	Percent agree (%)	Of those who agree with the statement			
		Moon worth it (%)	Program worth it (%)	Very worried (%)	Accident (%)
The 747 has been rushed into service before all of its mechanical equipment was properly tested	16.6	38.8	32.0	58.8	77.2
The new plane's engines are so powerful that they can create a serious noise problem around the airports where they land and take off	46.9	35.6	27.4	58.5	74.1
The 747 gives off too much smoke which will cause it to pollute the air in cities where it lands and takes off	36.5	34.4	25.4	59.9	75.0
The old jets served the needs of flyers and new bigger planes just are unnecessary	18.8	30.9	21.6	56.9	77.6

The eight statements about the 747 are arranged in terms of descending percentages who felt sending men to the Moon had been worth it. The first item describes the 747 as "sound technological progress," and the last one calls it "unnecessary." Among people who agreed with the first of these, 45.2 % felt the Moon landings were worth it, compared with only 30.9 %. The two extreme 747 items are indirectly measuring whether people felt the Apollo Program itself was "sound technological progress" or "unnecessary."

2.6 A Thoughtful Retrospective

As historian Roger Launius has repeatedly reminded us, at no point during the period that began with the first Sputnik in 1957 and ended either with the last Moon landing in 1972 or the joint American–Russian Apollo-Soyuz test project in 1975, did a majority of the American public support increased funding for space exploration. This was well known at the time, because the public opinion polls themselves received considerable publicity, and scholars commented about it soon afterward. But Launius has contributed more than just a reminder; he has offered analysis of the meanings of spaceflight for the American public at different points in time, especially during the Space Race and Apollo years. A brief consideration of the analysis in four of his journal articles is warranted here, not merely to give him credit for these contributions but to consider the range of hypotheses he offers. When Launius argues in favor of one of these ideas, I believe, he is primarily clarifying them through examples, but also offers confirming evidence in many instances.

Most obviously relevant is "Perceptions of Apollo: Myth, Nostalgia, Memory or All of the Above?" (Launius 2005). In this 2005 retrospective, informed by his knowledge of public opinion research but not delving deeply into it, Launius offers six plausible meanings that the Apollo program may have had, here described in my own terms:

1. A Mythic Event
   Much cultural anthropology supports the idea that every functioning culture possesses myths that define the society's values, express a fundamental conception of reality through poetic language, and assert that unified social life has transcendental meaning. For Americans, the Apollo program may have expressed a national ethic of heroism, nobility, and innovation.
2. The Agrarian Myth of the Frontier
   Just as Americans pioneered westward in the nineteenth century, they imagined they were pioneering upward in the twentieth. The concluding chapter of this book will explore the "space frontier" concept in some depth, but it must be noted here that the analogy between the Apollo program and the frontier of the Wild West is actually a poor one, if very popular, because the space program is a centrally controlled government enterprise, whereas the traditional frontier was individualistic and liberating.
3. Skepticism Unbound
   Some fraction of the American population has long doubted the promises of government leaders and of technological advance, so a pessimistic appraisal always existed in the public mind, as well as whatever positive enthusiasm the spaceflight social movement could generate. Launius presents this perspective as a reaction to disappointment that the agrarian myth of the frontier was not in fact fulfilled by Apollo, but in some quarters disillusionment was not necessary because the original illusions promoting Apollo were not universally accepted.
4. A Bastion of Concentrated Power
   Apollo was the child of the military-industrial complex, born in the technocratic Kennedy administration that believed every problem had a technical

solution, if managed wisely by the federal government. Given that all the early human space missions launched using adapted intercontinental ballistic missiles, and the later ones modified the military technology only moderately, it is easy to conceptualize Apollo as the upper stage of a governmental bureaucracy, the lower stage of which was war machinery.

5. A Grand Vision for the Future
   Incorporating an exploration mythos rooted in the European Age of Discovery more than in the American frontier myth, Apollo was a symbol of progress more generally. It was timely, because the dismal period of the Great Depression and Second World War had been followed by two decades of national security and economic development, but it was unclear how progress could continue after the earlier traumas had been completely healed.
6. Nostalgia
   Now that more than four decades have passed since the last human voyage to the Moon, many people romanticize Apollo and seek to recapture its lost idealism. Perhaps many people forget the chaos of the 1960s, or wish we could find in our past some shining light to illuminate our path forward, but nostalgia implies a lack of realism, as well as a degree of sadness.

In 2003 Launius had published "Public Opinion Polls and Perception of US Human Spaceflight." After presenting some of the poll data, he observed:

> These statistics do not demonstrate an unqualified support for NASA's effort to reach the Moon in the 1960s. They suggest, instead, that the political crisis that brought public support to the initial lunar landing decision was fleeting and within a short period the coalition that announced it had to reconsider their decision. It also suggests that the public was never enthusiastic about human lunar exploration, and especially about the costs associated with it. What enthusiasm it may have enjoyed waned over time, until by the end of the *Apollo* program in December 1972 one has the image of the program as something akin to a limping marathoner straining with every muscle to reach the finish line before collapsing (Launius 2003a).

In another 2003 journal article, Launius noted that the general public has always overestimated the fraction of the federal budget invested in space exploration, so conceivably informing the public better might increase support (Launius 2003b). In 2012 he suggested three lessons from the Apollo years that might help guide NASA in setting a new course after the space shuttle: (1) There was less popularity than Apollo's promoters expected. (2) The technological challenges were greater than initially perceived. (3) Promising too much can incur political costs (Launius 2012).

2.7 To Win Is to Lose

The Space Race illustrates the contingent quality of history, in which developments of great significance may depend upon the chance conjunction of multiple independent trends. We have already mentioned the 1960 election and the Vietnam War as cases in point, unrelated to spaceflight but affecting its course, but suppose the

Apollo Program had failed spectacularly on technical grounds. Three astronauts did die in Apollo 1, but in a test on the ground rather than in space, and three astronauts nearly lost their lives in Apollo 13. Suppose for example that the Apollo 1 fire had not ignited, and the safety improvements to the capsule had not been made. Then Apollo 11 might have been the one destroyed, perhaps during one of its lunar maneuvers, and imagine also that the Apollo 13 accident happened on Apollo 12, but with a fatal outcome. President Nixon could quite easily have called Apollo another Kennedy-Johnson folly and cancelled it. This point of this string of counterfactual assumptions is to set the stage for another possibility. In the late 1970s the Soviet Union could have reached the Moon first, causing the US to race it to Mars.

Remarkable events have more power when the lack of powerful public opinion commitments leaves open the possibility that politicians or social movement leaders will determine the course of history, using these events as rhetorical tools. This observation takes on more meaning in the context of a sociological theory that is exceedingly uncomfortable with this insight, technological determinism, which was introduced in the previous chapter. William F. Ogburn assumed that public opinion was significant only in the difficult process of adaptation to technological changes, not in creating them. If he was right, then the weak support given spaceflight by the general public could represent cultural lag, a reactionary pathology that will be cured by the passage of time.

So today the Space Race may have few lessons for the future of space exploration, unless we reach a second point in history at which rapid technological advance is possible, and unusual political conditions create an opportunity to invest sufficient funds in achieving it (Schulman 1975). The space race ended four decades ago, and we have not seen favorable conditions like those during that time. However, it is possible that American culture has been gradually eliminating the cultural lag that inhibits an alternate approach based on public enthusiasm for sustained if gradual progress. The best way to explore this possibility, while also identifying multiple meanings spaceflight may have acquired, is to examine public opinion data from a single, consistent study that covered the full set of years between the end of the Space Race and the analysis of the data here.

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Odum states: “Research publications, news or magazine articles and radio or television broadcasts employing statistical summaries of the Odum Institute data should give an appropriate citation to the Institute as the source of the data.” All the Harris data analyzed for this book came from the Odum Institute, and I deeply appreciate the contribution to social science and public awareness provided by Harris and Odum.

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